

# Dredging Research

Vol. 1, No. 1

Information from U.S. Army Engineer Waterways Experiment Station

March 1998

## Corps research will achieve efficient, environmentally sensitive dredging

by Elke Briuer, APR, U.S. Army Engineer Waterways Experiment Station

Since the earliest days of mankind, waterways provided the most efficient and economical means of transporting goods. This is still true today, when international commerce requires moving goods on a global scale. As the world's population continues to grow, demand for shipping space increases and advanced technology allows for vessels of ever-increasing sizes.

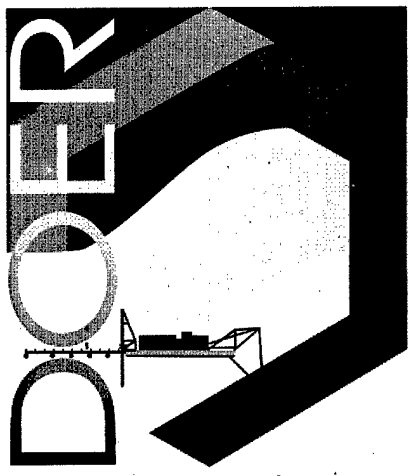
The dimensions of future shipping vessels far exceed the dimensions of waterways infrastructure in the United States, demanding continuous maintenance and enhancement, as well as new development. The U.S. Army Corps of Engineers is prepared to meet the challenge of future growth by conducting research and development that seeks to balance the need for maintaining a viable navigation system through dredging while providing necessary environmental protection and enhancement.

Historically, Corps dredging research in the 1970s focused on understanding ecological impacts of dredged material disposal, and on evaluating and managing sediments. In the 1980s, research concentrated on reducing costs of

dredging, improving dredging operations, and increasing project management efficiency. The challenge for the 1990s and the 21st century is balancing the navigation dredging mission with environmental protection criteria. To assist with this task, research at WES has integrated the operational and environmental aspects of dredging and disposal in the Dredging Operations and Environmental Research program. The DOER program's research results will provide dredging managers with

- technologies, methodologies, and techniques for cost-effective operation of dredging and disposal projects
- procedures for evaluating risks associated with management alternatives
- methods for rigorous technical evaluation of environmental restrictions that improve dredging operations flexibility.

Dr. Robert M. Engler, executive manager of the DOER program said, "U.S. dredging now costs more than \$500-million per year. These costs are still increasing because of ever new environmental protection requirements issued by federal and state agencies. Federally funded dredging projects bear these costs." Engler added that research and development is an integral component of managing the United States dredging program. "Corps managers want to assure an efficient and environmentally sustainable navigation system. Our research is designed to help dredging managers do their jobs fiscally efficient and environmentally effective," said Engler.



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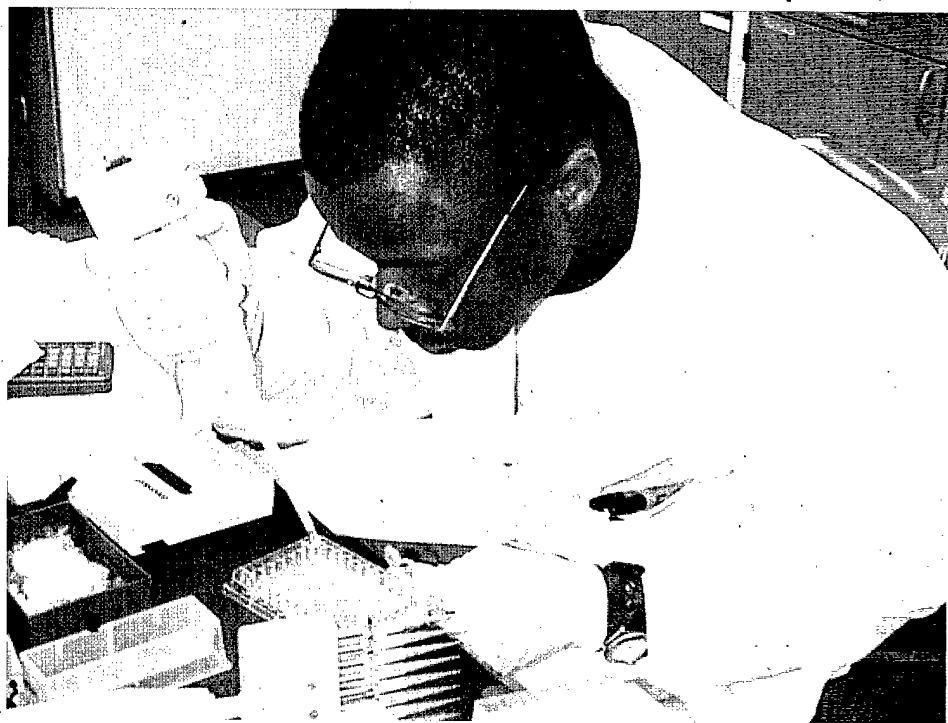
## DOER research focus

The DOER program addresses management concerns identified by field office personnel. The program has six research focus areas, each managed by a lead principal investigator.

Dr. Michael R. Palermo oversees the area titled **Contaminated Sediment Characterization and Management**. Contaminated sediments in many harbors and waterways contribute to pollution of waterways. They also limit the ability of the Corps to dredge, transport, and relocate sediments. Chlorinated hydrocarbons such as dioxins are a serious threat to the environment and human health. These pollutants can cause significant project delays and cost increases because they must be confined, contained, or treated or they cannot be dredged. DOER research concentrates on developing rapid and inexpensive screening tools for contaminants, guidance for contaminant pathway assessments, as well as design guidance for contaminant controls and management.

Dredging operations are routinely limited to certain time periods, known as "environmental windows," in order

The DOER program strives to balance operational and environmental constraints. Research is performed by a multi-disciplinary team at WES. The program began in October 1996, and is scheduled for completion at the end of fiscal year 2004. Corps headquarters program monitors are Barry Holliday, Joseph R. Wilson, John Bianco, and Charles Chesnutt. The DOER executive program manager is Dr. Robert Engler, WES EL, phone (601) 634-3624, e-mail [englerr@mail.wes.army.mil](mailto:englerr@mail.wes.army.mil). DOER operational program manager is Clark McNair, WES CHL, phone (601) 634-2070, e-mail [mcnairc@mail.wes.army.mil](mailto:mcnairc@mail.wes.army.mil). The program's Web sites can be reached from [www.wes.army.mil/el/dots/doer/](http://www.wes.army.mil/el/dots/doer/).



to protect biological resources or their habitats. Compliance with windows can add to the overall cost of a dredging project. Some windows are applied based on subjective or inconsistent information, and may be over-restrictive, according to Dr. Douglas Clarke, focus area manager for **Environmental Windows for Dredging Operations** research. This research seeks to strike a balance between resource protection and cost-effective dredging operations by addressing underlying technical issues. "Rigorous investigations are planned in collaboration and partnership with interested resource agencies. We will formulate an adequate base of knowledge upon which to objectively evaluate the need for windows on a project-by-project basis. We will also develop effective operational measures to avoid or reduce the need for windows," said Clarke.

The importance of risk recognition, evaluation, and the resulting decision making cannot be underestimated, according to Dr. David Moore, who heads the research team examining **Ecological Risk Management for Dredging and Disposal Projects**. Moore said that risk evaluation methodology crosses over most of the other

focus areas in DOER and that many people are uncomfortable with the subject. Therefore, the approach is to develop characterization and management tools for risks associated with dredging and disposal activities. Modeling, software, and database development will be central to the work. "We plan to demonstrate how to use risk assessment for various projects, and we will incorporate economic factors into the risk management modules," he said.

Research in the **Innovative Dredging Equipment and Process Technologies** focus area will identify and demonstrate emerging dredging and disposal technologies used by industry worldwide. Working with field office representatives, the researchers will find those technologies that indicate cost savings and demonstrate new equipment and techniques. "The final stage will be recommendations for implementing the best suited technologies," stated Mr. E. Clark McNair, DOER Operational Program Manager.

**Instrumentation for Dredge and Site Monitoring** is overseen by Mr. James Rosati III. The research focuses on techniques and standards

for monitoring dredge operations, compliance and assessment. Results will include automating contract dredge inspections via silent inspectors for hopper, pipeline and mechanical dredges and disposal scows. Rosati and his team are developing Tons Dry Solids hopper dredge load measurements that give the dry weight of the hopper load. "We are also performing research that will optimize bottom and contaminant characterization technology," said Rosati.

A critical factor for cost-effective dredging is the ability to place sedi-

ments dredged from navigation channels in nearby aquatic sites. Concerns from regulators and resource agencies over environmental or aesthetic impacts often restrict cost-effective placement options. In the **Nearshore Placement of Dredged Material** focus area, Mr. James E. Clausner is coordinating research that will expand aquatic placement options for dredged material. "A major effort will be to thoroughly monitor a prototype placement of mixed sand and fine grained sediments nearshore, allowing this marginal beach fill material to benefit the littoral zone while keeping costs low," said Clausner. Equally important will be to expand numerical modeling capabilities for predicting the fate of dredged material placed in a range of aquatic environments. "After sediment transport numerical models are developed and field verified, we can provide convincing arguments to the resource agencies for expanding cost effective placement options" Clausner said.

DOER research work units are primarily short term studies of approximately three year duration. The emphasis is on immediate technology transfer of product to the field. The primary vehicle to convey information is the World Wide Web and the preferred

### ***DOER Program publishes first technical note on fate and effects research results***

WES scientists have developed a tool that will reduce the cost of conducting environmental risk assessments. An analytical screening method measures bioavailable dioxin at 10 percent of cost and time required by previous methods. A technical note containing guidance for performing the H4IIE Dioxin Screening Assay has recently been published and placed on the internet [www.wes.army.mil/el/dots/doer/](http://www.wes.army.mil/el/dots/doer/). The publication provides protocols for analysts who may wish to gain the capability for performing the assay with a detailed blueprint of how the assay is conducted and what is necessary in terms of technique, materials, instrumentation, and time. DOER technical notes will be exclusively available from the website.

format will be technical notes. There will, however, be reports and fact sheets as well as other media for the DOER program. The address for DOER information is [www.wes.army.mil/el/dots/doer/](http://www.wes.army.mil/el/dots/doer/).

### ***DOER technology transfer goes hi-tech***

The DOER program technology transfer approach is looking at real-time access by publishing research products on the World Wide Web. To date, three technical notes have been published in portable document format (.pdf) and placed online, making new technology available within hours of final approval for release. This approach places products into the hands of the users 45 to 60 days earlier than paper copies, resulting in timely and cost effective technology transfer.

## **WES participates in Puget Sound multi-user disposal site study**

A system of multi-user disposal sites for contaminated sediments dredged from Puget Sound is under consideration. To determine the feasibility of such a system, personnel from the Corps Seattle District and the State of

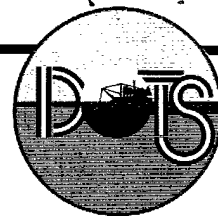
Washington are conducting a study. In support of this study, WES researchers are developing conceptual designs and performance standards for subaqueous capping, contained aquatic disposal, and upland and nearshore confined dis-

posal facilities, as well as testing and monitoring requirements. Point of contact for additional information from WES is Dr. Michael R. Palermo, (601) 634-3753, [palermmm@mail.wes.army.mil](mailto:palermmm@mail.wes.army.mil).

### ***Environmental Residue-Effects Database (ERED) now available on-line***

ERED ([www.wes.army.mil/el/dots](http://www.wes.army.mil/el/dots)) is an international, centralized, easily accessible repository of data that links measured tissue concentrations of contaminants to biological responses. Developed by WES scientists with support from the U.S. Environmental Protection Agency, this database is useful to managers who must interpret the environmental meaning of bioaccumulation as required by statutes and regulations. Time and cost savings are significant, since decision-makers can access the database in real time free of charge. Additional information is available from Dr. Todd Bridges, (601) 634-3626, [bridget@mail.wes.army.mil](mailto:bridget@mail.wes.army.mil).

# **E2D2** searchable database for dredging literature on web



The Dredging Operations Technical Support Program provides direct environmental and engineering technical support to the U.S. Army Corps of Engineers Operations and Maintenance dredging mission. All dredging research activities at the Waterways Experiment Station are conducted under DOTS, including a strong technology transfer program. Developed under the DOTS program, the Environmental Effects & Dredging and Disposal (*E2D2*) is a searchable database on the World Wide Web for technical dredging literature. The database currently includes approximately 1,700 Corps and other federal and state agency publications, journal articles, and proceedings of symposia and specialty conferences.

A wide range of topics that relate to the environmental effects of dredging

and dredged material disposal projects are referenced. Included are beneficial uses of dredged material, effects of sediment resuspension and sedimentation on aquatic organisms and their habitats, and contaminated sediments. *E2D2* is an ongoing project, and will include additional dredging topics.

Currently, three Corps publication series are included in the database:

- ↳ the Dredged Material Research Program (DMRP) series, which ended in 1979
- ↳ the Disposal Area Monitoring System (DAMOS) Technical Notes
- ↳ the Environmental Effects of Dredging Technical Notes

The database is available to users world wide. Users are able to perform both simple and advanced queries in the database on author, title, journal, report, conference, keyword, and publi-

cation year or span of years. All references contain pertinent information to assist the user in identifying a source for the reference. A large number of noncopyrighted material citations in *E2D2* include abstracts, introductions, or summaries.

*E2D2* can be found at [www.wes.army.mil/el/e2d2](http://www.wes.army.mil/el/e2d2). The DOTS Program Monitor is Joseph Wilson, [Joseph.R.Wilson@HQ01.usace.army.mil](mailto:Joseph.R.Wilson@HQ01.usace.army.mil). *E2D2* is maintained by WES, point of contact, Dr. Douglas Clarke, [clarked@mail.wes.army.mil](mailto:clarked@mail.wes.army.mil). *E2D2* Site Manager is Virginia Dickerson, [dickerv@mail.wes.army.mil](mailto:dickerv@mail.wes.army.mil). DOTS Program Manager at WES is Thomas Patin, [patint@mail.wes.army.mil](mailto:patint@mail.wes.army.mil).

## **Center for Contaminated Sediments**

### **WES center of expertise for top scientists and engineers working with contaminated sediments**

The U.S. Army Corps of Engineers recently established the Center for Contaminated Sediments (CCS) at the WES, consolidating research expertise to deal with the problem of contaminated sediments. The Center coordinates and facilitates contaminated sediment activities between WES and other Corps organizations, the Department of Defense, other federal and state agencies, academia, and the private sector. Dr. Robert M. Engler, is the Director of the CCS.

Center activities focus on identification, assessment, evaluation, and management of contaminated sediments. Included are research and development on endangerment assessments, risk analysis, restoration, remediation, and

management activities. Field assistance, technology transfer, training workshops and seminars, and response to general information requests are also functions of the Center.

With more than two decades of experience in various aspects of identifying, delineating, assessing, remediating, and managing contaminated sediments, "WES engineers and scientists are on the cutting edge of research in this important area," said Engler. This WES expertise is a direct result of research and development activities funded

↳ In support of the Corps of Engineers dredging mission as well as reimbursable work related to military cleanup activities

↳ The Environmental Protection Agency's Superfund and Assessment and Remediation of Contaminated Sediments Programs

↳ The National Oceanic and Atmospheric Administration's Natural Resource Trustee Program.

Additional information is available by contacting Engler at U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, phone: (601) 634-3624, e-mail: [englerr@mail.wes.army.mil](mailto:englerr@mail.wes.army.mil).

(Ed. Note: *Dredging Research* will feature the CCS in its June 1998 issue.)

# GIS Based Software to Assist Dredging Project Managers

Managing dredging and dredged material placement has become more complicated as the number of regulations applicable to these activities have increased, and resource agencies and environmental groups have subjected the Corps to greater scrutiny on dredging projects. However, a customized Geographic Information System (GIS) based software system for PC use can facilitate dredging project management.

Challenges faced by the New York District in managing their open water disposal site, the Mud Dump site resulted in development of a district-specific software package for site management. Named "Disposal Analysis Network for New York" and completed in June 1997, DAN-NY was a joint effort between the U.S. Army Engineers Waterways Experiment Station and two contractors, Science Applications International Corporation and Applied Science Associates.

## Background

Historically, the Mud Dump site is a difficult open water dredged material placement site. It is a 2.1 km by 3.7 km rectangle located 11 km east of Sandy Hook, N.J., and has been used since interim designation in 1973. The site's proximity to commercial and recreational fishing areas, historic disposal sites, and heavy shipping through the approaches to New York Harbor creates a unique set of circumstances. Since site designation, an average of 4.3 M m<sup>3</sup> per year of mostly fine grained maintenance material from an average of more than 20 federal and private projects has been deposited there. District personnel needed to meet challenges in three different areas:

↳ Concerns over site capacity

- ↳ Desire to improve capping of contaminated dredged materials placed in the Mud Dump site
- ↳ Access to information about existing data locations and storage media for decision making

## Phased Implementation

DAN-NY development commenced in phases. Phase 1, a system design study, defined data types, hardware, software, costs and schedule for implementing subsequent phases. Following completion of Phase 1 in May 1996, Phase 2 was to design and implement the system, including developing and documenting data management systems and training of New York District and WES staff. Concurrent with Phase 2 was Phase 3, which selected the data needed and then populated the databases. Phases 2 and 3 were completed in June 1997. Phase 4, now underway, will maintain the system, add enhanced software and analysis, and will continue database expansion through data set additions.

DAN-NY functions at two levels. It has quick access to maps and summary information for use by upper level management or in-depth (extended analysis) capabilities for the technical user. Quick access features (available by selecting one or two options from the opening menu) allow the user to view and print any bathymetric survey in the database along with the more recent barge placement locations. In the extended capabilities mode, the user

has access to an array of tools that will apply to many day-to-day activities as well as longer term planning and design related studies. In addition to the more obvious abilities to display bathymetric survey data in a wide range of options, DAN-NY can compute site capacity, predict mound geometry using the Dredging Research Program developed Multiple Dump FATE of dredged material (MDFATE) model (Moritz and Randall 1995), display the mound created and compute volumes, associate mounds with buoy locations, review barge disposal logs, view sediment profile images (SPI), etc.

## Hardware and Software

With the exception of the specialized software applications developed by SAIC and ASA, all the hardware and software for DAN-NY are non-proprietary and readily available. DAN-NY is used on a PC with minimum capabilities of a 166 MHz CPU, 32 Mbytes of RAM, 2 Gbyte hard drive, 6x CD-ROM. All software is 32-bit to increase operating speed, the operating system is Windows NT 4.0, the GIS system is ArcView 3.0, the data base is Microsoft Access. A GIS expert is not required to operate DAN-NY. Most of the functions a site manager would require are built-in. Present users of DAN-NY were proficient with the software after 2 days of training. Training for the quick access features takes 2-3 hours. Databases are stored on CD-ROM (see Table 1 for information).

**Table 1. Data Types Included in DAN-NY**

Bathymetry (>27 Surveys)	Side Scan Sonar (2 Surveys/1 Image)
Sediment Profile Imagery (10 Surveys)	Plan Form Photographs (5 Surveys)
Sediment Chemical and Physical Analyzes (7 Surveys)	Tissues Analyzes (Chemical and Physical Analyzes (4 Surveys)
Barge Disposal Logs (1,785 Logs)	Disposal Buoy Locations (645 Logs)



# Leaching test guidance for dredged material disposal activities issued by Corps Headquarters

by Marsha C. Gay, U.S. Army Engineer Waterways Experiment Station

Guidance for leachate pathway impacts analysis for dredged material disposal activities was recently published by Headquarters, U.S. Army Corps of Engineers. This guidance applies to dredging projects undertaken or regulated by the Corps.

For 25 years, Corps engineers and scientists conducted research leading to the development of procedures and tests for evaluating multimedia dredged material disposal alternatives. An important environmental concern is that contaminated dredged material is sometimes placed in upland contained disposal facilities. From there, contaminants could leach into groundwater and surrounding surface water.

WES scientists and engineers conducted studies under the Long-Term Effects of Dredging Operations (LEDO) research program developing tests for preproject prediction of leachate

quality in CDFs. The research used laboratory procedures to simulate leaching of dredged material in CDFs. The leaching tests were developed to fill the gap in the technical framework on leachate testing. These tests are now ready for routine application in the evaluation of confined disposal alternatives for dredged material.

Leachate testing is not always required for dredged material disposal in CDFs, but must be justified on a project-by-project basis when leachate is a potential contaminant pathway. Justifications include sediment contamination, CDF site conditions that indicate a potential for leachate seepage, or, as required by the state, a water quality certification for effluent discharged from the weirs.

The new leaching test guidance may be periodically updated as the state of the science advances. Copies of current guidance with references are available

online at the Corps Dredging Operations Technical Support home page in .pdf format at [www.wes.army.mil/ell/dots](http://www.wes.army.mil/ell/dots). The references provide

- ↳ General guidance on leachate as a migration pathway at CDFs
- ↳ Procedures for evaluating leachate quality for freshwater dredged material disposed in CDFs
- ↳ Procedures for evaluating leachate quality for estuarine and salt water dredged material in CDFs.

Policy questions should be directed to Joe Wilson at Corps Headquarters, (202) 761-8846, e-mail: [Joseph.R.Wilson@HQ01.usace.army.mil](mailto:Joseph.R.Wilson@HQ01.usace.army.mil). Point of contact for additional technical information is Tommy Myers, Environmental Laboratory, WES, (601) 634-3939, e-mail: [myerst@mail.wes.army.mil](mailto:myerst@mail.wes.army.mil).

## Articles for Dredging Research requested

*Dredging Research* is an information exchange bulletin for publication of WES generated dredging research results. Included are articles about applied research projects. The bulletin serves all audiences and is accessible on the World Wide Web in addition to a circulation of 2,800.

Articles from non-WES authors are solicited for publication, especially if the work described is tied to the use of WES generated research results. Research articles that complement WES research or cover wide field applications are also accepted for consideration. Manuscripts should include suggestions for visuals and a brief biography of the author and should use a non-technical writing style. Point of contact is Elke Briuer, APR, at [briuer@mail.wes.army.mil](mailto:briuer@mail.wes.army.mil).

## International

### PIANC to meet in summer

Dr. Robert M. Engler, Senior Scientist from the WES Environmental Laboratory and a Permanent International Association of Navigation Congresses member, will attend the 29th Congress of PIANC in The Hague, Netherlands, Aug. 28 to Sept. 4, 1998.

### London Convention to be held in South Africa

The meeting of members of the London Convention will be held in Cape Town, South Africa, on April 6 to 9, 1998. Dr. Robert M. Engler is a member of the United States delegation and will attend the meeting.

## **New *Inland Testing Manual* adds protocol information to Section 404 of Clean Water Act**

Guidance published in the new *Inland Testing Manual*, a joint Corps and EPA publication, will be phased in during the next 18 months. The document provides information regarding technical protocols under Section 404 of the Clean Water Act for evaluating proposed discharges of dredged material associated with navigational dredging projects into waters of the United States.

It replaces existing guidance now found in the Gold Book (*Ecological Evaluation of Proposed Discharge of Dredged for Fill Material into Navigable Waters*). The ITM incorporates a number of scientific advances including new laboratory techniques, test species, procedures, detection limits, and evaluation protocols that represent the current state of knowledge for dredged material testing and evaluation. The manual provides information needed to determine the potential for contaminant-related impacts of proposed discharges thus avoiding unnecessary testing and evaluation. Its format allows the incorporation of improved methods and techniques and the state of the science advances. The ITM is available on the World Wide Web from the Corps Dredging Operations Technical Support home page [www.wes.army.mil/ell/dots/](http://www.wes.army.mil/ell/dots/) or at the EPA web site [www.epa.gov/OST/pubs/ITM.html](http://www.epa.gov/OST/pubs/ITM.html). Point of contact at WES is Thomas Patin, (601) 634-3444 [patint@mail.wes.army.mil](mailto:patint@mail.wes.army.mil).

## **Dredged Material Assessment and Management Seminar to be held in Buffalo**

The Corps/EPA-sponsored Dredged Material Assessment and Management Seminar will be held in Buffalo, N.Y., July 28 to 31, 1998, at the Adam's Mark Hotel (see note). On the agenda is an overview of the Automated Dredging and Disposal Alternatives Modeling System. ADDAMS is a personal-computer-based design, analysis, and evaluation system for dredged material disposal and management. The seminar will also cover application of all tiers of the *Inland Testing Manual*, a review of the EPA/CE *Technical Framework* for disposal alternative selection, application of risk assessment methodology, toxicological assessment techniques, land placement methods, and beneficial uses. In addition, DMSMART, a comprehensive computer-based system integrating nearshore dredged material placement design aspects currently under development, will be introduced. More information is available on the World Wide Web at [www.wes.army.mil/ell](http://www.wes.army.mil/ell) under "Calendar of Events." (Note: formerly the Buffalo Hilton Hotel)

## **Calendar of Events**

- May 7 - 9, 1998 First Annual Conference of the Northeast Chapter American Shore and Beach Preservation Association  
"Local Efforts in Shoreline Management and Protection"  
Ocean City, NJ USA  
Abstracts Due: 28 February 1998  
POC: Rich Weggel (215) 576-6307  
Bob Sorensen (610) 758-3556
- May 13 - 15, 1998 Harbors, Navigation and Environment  
AAPA  
Warwick Hotel  
Philadelphia, PA USA
- May 19 - 23, 1998 International Coastal Symposium  
The Breakers Hotel  
Palm Beach, FL USA  
POC: [am&m@allenpress.com](mailto:am&m@allenpress.com)
- May 27 - 29, 1998 National Symposium on Contaminated Sediments:  
Coupling Risk Reduction with Sustainable Management and Reuse  
National Academy of Sciences Building  
Washington, DC USA  
POC: [jcambridg@nas.edu](mailto:jcambridg@nas.edu)
- Jun 7 - 9, 1998 International Conference on Rehabilitation of Harbour Areas  
Lisbon, PORTUGAL  
POC: [mrta@lnec.pt](mailto:mrta@lnec.pt)
- Jun 24 - 25, 1998 National Coastal Summit  
Washington, DC USA  
POC: [acc.summit@mail.netlobby.com](mailto:acc.summit@mail.netlobby.com)
- Jun 22 - 26, 1998 ICCE 98  
26th International Conference on Coastal Engineering  
Radisson SAS Falconer Hotel  
Copenhagen, Denmark  
POC: ICCE 98  
c/o Danish Hydraulic Institute  
Agern Alle 5, DK-2970 Horsholm, Denmark  
Voice: +45 45 76 95 55  
Fax: +45 45 76 25 67  
E-mail: [icce98@dhi.dk](mailto:icce98@dhi.dk)  
Abstracts Due: 1 June 1997  
POC: [b-edge@tame.edu](mailto:b-edge@tame.edu)
- Jun 28 - Jul 2, 1998 WODCON XV: Fifteenth World Dredging Congress  
Mirage Hotel and Casino  
Las Vegas, NV USA  
POC: Larry Patella  
World Dredging Association  
PO Box 5797  
Vancouver, WA USA 98668-5797  
Voice: (503) 285-5521  
Fax: (503) 240-2209
- Jul 12 - 15, 1998 16th Conference of The Coastal Society  
"Minding the Coast: It's Everybody's Business"  
Williamsburg, VA USA  
Abstracts Due: 1 December 1997  
POC: [tcs@vims.edu](mailto:tcs@vims.edu)
- Jul 28 - 30, 1998 Dredged Material Assessment and Management Seminar  
Adam's Mark Hotel, Buffalo, N.Y.  
U.S. Army Corps of Engineers & EPA sponsored  
POC: Jeannie Roper [roperj@mail.wes.army.mil](mailto:roperj@mail.wes.army.mil)  
Online: [www.wes.army.mil/ell/whatsnew.html](http://www.wes.army.mil/ell/whatsnew.html)